EXPERIMENTAL ANALYSIS OF SHOT ñPEENED THIN ALUMINUM FATIGUE SPECIMENS

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ABSTRACT

An experimental program, in support of the theoretical/numerical analyses at the University of California at Irvine, was initiated at the University of Washington. The objective of this research is to coordinate experimental data in an effort to enhance the existing AFGROW/NASGRO da/dN database in AGILE. Results will also be validated with SGBEM-FEAM numerical results from AGILE.

Uniaxial elastic-plastic tensile stress-strain data, for un-shot peened and shot-peened, 1.8 mm-thick 7075-T73 plate, using miniature dog bone tensile specimens, was generated as the part of the two-dimension constitutive relation for the SGBEM-FEAM code. All shot peening was conducted with a 25.4-mm diameter nozzle at an intensity of 0.007 with shot sizes of 230-280.

1.8 mm thick, double-edged, V-notched, 7075-T73 aluminum fatigue specimens will be fatigued at 30 Hz with R= 0.1 and a nominal applied maximum stress of 98.8 MPa**.** Half of these specimens are shot peened. Displacement and total strain fields at unload and at the maximum fatigue stress of 98.8 MPa will be recorded by moirÈ interferometry with a displacement sensitivity of 6.25 μm. These displacement and strain recordings will be made at the start of fatigue crack growth, a ≈1 mm, and at subsequent incremental crack growth of Δa ≈ 1 mm to a final crack length of a ≈ 5 mm. The inevitable tunneling of the fatigue crack front in these thin specimens will be observed by fracturing the specimens after the final fatigue testing. The fatigue crack initiation and the da/dN data together with the residual displacement/strain fields at unload and displacement/strain field at maximum fatigue load will be compared with the corresponding numerical data generated at UCI.

In a companion program, a theoretical model for the residual stress-field generated near the surface of a shot-peened structure, as a function of the various shot-peening parameters, is being developed at UCI. Also, the effect of these residual stress fields , on the retardation of growth of 3-D surface flaws is being quantified at UCI.

First, the residual stress-field in a thin specimen with a through-the-thickness, as shtpeened at the University of Washington, will be predicted using the theoretical model developed at UCI. Using AGILE, and the above residual stress ñfield as input, the tunneling of a through the thickness crack under fatigue will be predicted at UCI, and compared with the corresponding experimental results generated at the University of Washington.

The end-product of this research is the development of a validated AGILE that can reasonably predict the no-planar crack-growth in shot-peened primary structural elements in rotorcraft, under fatigue loading.